Claims

What is claimed is:

1. A method for accuracy-aware analysis of a program, comprising:
   obtaining source code for the program comprising a floating point variable;
   instrumenting the source code to associate an accuracy-aware tracking structure with the floating-point variable to obtain instrumented source code;
   compiling to instrumented source code to obtain instrumented compiled code; and
   executing the instrumented compiled code, wherein executing the instrumented compiled code comprises using the accuracy-aware tracking structure to track an operation on the floating-point variable.

2. The method of claim 1, further comprising:
   generating an accuracy-aware analysis report using the accuracy-aware tracking structure.

3. The method of claim 2, wherein the accuracy-aware analysis report includes at least one tracking variable associated with the floating-point variable selected from the group consisting of an error variable, a scaled mantissa digits variable, a renormalization variable, a left digit destruction variable, and an operations variable.

4. The method of claim 3, wherein the error variable comprises a half unit in last place variable.

5. The method of claim 4, wherein a value of the half unit in last place variable is determined using information obtained during renormalization.

6. The method of claim 3, wherein the error variable comprises an upper limit interval variable and a lower limit interval variable.

7. The method of claim 3, wherein an operations variable comprises at least one selected from the group consisting of a multiplication variable, a division variable, and a square root variable.

8. The method of claim 3, wherein the renormalization variable tracks the number of addition and subtraction operations performed on the floating-point variable that do not involve left digit destruction.

9. The method of claim 1, wherein executing the compiled instrumented code comprises:
   performing the operation on the floating-point variable to obtain a result;
   incrementing a tracking variable corresponding to the operation associated with the floating-point variable;
   determining whether the result is exact using a scaled mantissa of the result; and
   quantifying error associated with the result if the result is not exact.

10. The method of claim 9, further comprising:
   updating error variable using data obtained from quantifying the error associated with the result, if the result is not exact.

11. The method of claim 9, further comprising:
   determining whether the result exceeds an accuracy threshold if the result is not exact.

12. The method of claim 11, wherein execution of the compiled instrumented code halts if the accuracy threshold hold is exceeded.

13. The method of claim 11, wherein the accuracy threshold comprises at least one selected from the group consisting of a relative error threshold, an absolute error threshold, and a comparison test.

14. The method of claim 1, further comprising:

setting an accuracy threshold for the program.

15. The method of claim 1, wherein instrumenting the source code comprises:
    parsing the source code to obtain the floating-point variable; and
    inserting additional source code to update the accuracy-aware tracking structure associated with the floating-point variable.

16. The method of claim 15, wherein the additional source code comprises functionality to call into a runtime logging utility, wherein the runtime logging utility updates the accuracy-aware tracking structure associated with the floating-point variable.

17. The method of claim 1, wherein the floating-point variable is double type.

18. A system for performing accuracy-aware analysis on a program, comprising:
    a source code defining the program comprising a floating point variable;
    a preprocessor configured to instrument the source code, wherein instrumented source code comprises an accuracy-aware tracking structure associated with the floating-point variable;
    a runtime utility configured to track an operation of the floating-point variable and update the accuracy-aware tracking structure associated with the floating-point variable; and
    a runtime environment configured to execute the instrumented source code and the runtime utility.

19. The system of claim 18, wherein the runtime environment is further configured to generate an accuracy-aware analysis report, wherein the accuracy-aware analysis report is generated using the accuracy-aware tracking structure associated with the floating-point variable.

20. The system of claim 19, wherein the accuracy-aware analysis report includes at least one tracking variable associated with the floating-point variable selected from the

group consisting of an error variable, a scaled mantissa digits variable, a renormalization variable, a left digit destruction variable, and an operations variable.

21. The system of claim 20, wherein the error variable comprises a half unit in last place variable.

22. The system of claim 21, wherein a value of the half unit in last place variable is determined using information obtained during renormalization.

23. The system of claim 20, wherein the error variable comprises an upper limit interval variable and a lower limit interval variable.

24. The system of claim 20, wherein an operations variable includes at least one selected from the group consisting of a multiplication variable, a division variable, and a square root variable.

25. The system of claim 20, wherein the renormalization variable tracks the number of addition and subtraction operations performed on the floating-point variable.

26. The system of claim 16, wherein executing the compiled instrumented code comprises:

performing the operation on the floating-point variable to obtain a result;

incrementing a tracking variable corresponding to the operation associated with the floating-point variable;

determining whether the result is exact using a scaled mantissa of the result; and

quantifying error associated with the result, if the result is not exact.

27. The system of claim 26, further comprising:

updating error variable using data obtained from quantifying the error associated with the result, if the result is not exact.

28. The system of claim 21, wherein execution of the compiled instrumented code halts if the accuracy threshold hold is exceeded.

29. The system of claim 23, wherein the accuracy threshold comprises at least one selected from the group consisting of a relative error threshold, an absolute error threshold, and a comparison test.

30. A computer system for performing accuracy-aware analysis on a program, comprising:

a processor;

a memory;

a storage device; and

software instructions stored in the memory for enabling the computer system under control of the processor, to:

obtain source code for the program comprising a floating point variable;

instrument the source code to associate an accuracy-aware tracking structure with the floating-point variable to obtain instrumented source code;

compile to instrumented source code to obtain instrumented compiled code; and

execute the instrumented compiled code, wherein executing the instrumented compiled code comprises using the accuracy-aware tracking structure to track an operation on the floating-point variable.